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ABOUT PERFECTION OF SPATIAL GEARINGS

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Summary. Synthesis of spatial gearings on the basis of the initial surfaces least deviating from hyperboloid axoids that is a perspective direction of essential increase in durability and improvement of performance qualities screw, worm, spiroid and hypoid gearing. Results of the researches showing the big perspectives of gearing Novikova, than involute gear are resulted.

Key words: platforms of instant contact, factor of score-resistance, factor of a comparative, hyperboloid gears.

INTRODUCTION

The put forward hypothesis [11] about a geometrical reserve of perfection screw, worm, spiroid and hypoid gears has calculation confirmation consisting in the following.

Score-resistance gears by gearing increases with increase in speed and $V^{(\Sigma)}$ with reduction of speed $V^{(12)}$. Therefore score-resistance gears can characterize, in certain degree, factor [10]:

$$K_v = V^{(12)} / V^{(\Sigma)} . \quad (1)$$

Physical sense: reduction (increase) K_v means increase (reduction) score-resistance gear pair.

At the appendix to axes of cogwheels of the twisting moments in places of contact of teeths arise, as is known, distributed on platforms of instant contact (PIC) efforts which it is accepted to represent in the form of the concentrated force operating P_N perpendicularly contacting surfaces of teeths in central point PIC.

On PIC in an action direction P_N there are contact pressures σ_H. The greatest pressure of compression counted under known [8] formula of Hertz, takes place in centre PMK

$$\sigma_{H\max} = 3P_N / 2\pi ab . \quad (2)$$

Here: a, b sizes of the big and small semi axis elliptic PIC.

Contact pressure σ_H create in a blanket of metal the pressure reaching σ_K greatest (dangerous) value on some depth, depending on a deviation b/a. However the greatest shearing pressure in a dangerous point does not depend almost on the relation b/a:

$$\tau_{\max} \approx 0,32\,\sigma_{H\max}. \tag{3}$$

Under the influence of force P_N the tooth is bent, and in its basis arise bending stress σ_F.

As the effort P_N is distributed on all platforms of instant contact by the area:

$$S = \pi ab, \tag{4}$$

that with increase in this area decrease as contact, and bending stress.

For two gears compared further (indexes "I", "II"), subject to action of identical force, P_N being guided by formulas (2) - (4), we will write down obvious identities

$$\frac{\sigma_{H\max I}}{\sigma_{H\max II}} = \frac{\tau_{\max I}}{\tau_{\max II}} = \frac{S_{II}}{S_I} = \frac{a_{II}b_{II}}{a_I b_I},$$

Which kernel is the parity:

$$K_S = a_{II}b_{II}/a_I b_I. \tag{5}$$

OBJECTS AND PROBLEMS

According to stated, the factor K_S characterizes, in certain degree, a comparative intense condition of teeths of two gears.

Physical sense: the inequality $K_S < 1\ (K_S > 1)$ testifies to smaller pressure in teeths of the first (second) transfer; equality $K_S = 1$ testifies about approximately equal condition of teeths of compared gears.

To numerical comparative research were exposed hyperboloid gears: with gearing Novikova (initial surfaces least deviate from hyperboloid axoids), with gearing of type Novikova (initial surfaces - conic), with involute gearing (initial surfaces least deviate from hyperboloid axoids), with involute gearing (initial surfaces - conic), globoid gear.

Factor K_v of score-resistance and factor of a comparative K_S intense condition of teeths – corner functions of α_1. Factors were calculated on coal (α_w hailstones) of duration of gearing of pair teeths, that is at, $\alpha_1 \in [-0,5\alpha_w; 0,5\alpha_w]$ under formulas (1) and (5) on the basis of functional expressions of quality indicators, $V^{(\Sigma)}$ $V^{(12)}$ *a*

from b work [10], on the basis of the equations of active surfaces of teeths and unit normal vectors to them from works [8], [10], for angular speed of a driving wheel is glad/sek, $\omega_1 = 1$ for fixed (identical to compared gears) values of loading, P_N factor Puasson and the module of elasticity the Ship's boy [8]. The geometry kinematic parameters of gears: $m_n = 3$ mm; $Z_1 = 13$, $Z_2 = 54$; $E = r_1 + r_2$, ($r_1 = r_2 = 26{,}344$ mm); $u_0 = 1/i = 0{,}2407$; $\gamma = \beta_1 + \beta_2$, ($\beta_1 = 74^0 34'$, $\beta_2 = 15^0 26'$).

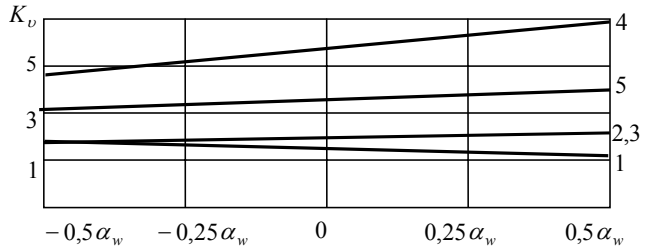

Fig. 1. Factor K_υ score-resistance teeths hyperboloid gearing: 1 – with gearing Novikova (initial surfaces least deviate from hyperboloid axiods); 2 – with gearing of type Novikova (initial surfaces -- conic); 3 – with involute gearing (a line with from fig. 2; initial surfaces least deviate from hyperboloid axiods); 4 – with with involute gearing (initial surfaces -- conic); 5 – globoidal gear

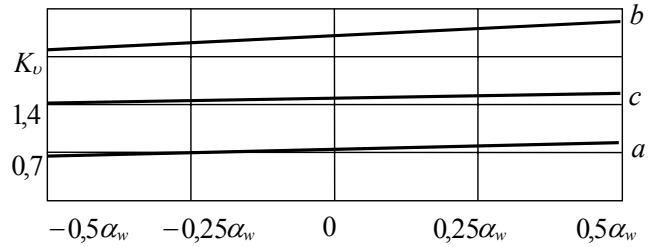

Fig. 2. Hipoid gear with involute gearing (on fig. 1 – number 3).
Factor K_υ score-resistance teeths:,
a - b in trailer, - c in median points of a line of instant contact

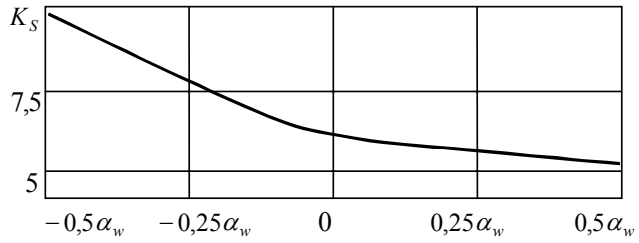

Fig. 3. Factor K_S of a comparative intense condition of teeths hypoid gears with gearing of type Novikova (in the formula (5) – transfer I ; initial surfaces -- conic) and with gearing of type Novikova (in the formula (5) – transfer II ; initial surfaces least deviate from hipoid axoids)

Results of calculation are reflected on fig. 1-3. In these drawings from four considered types hyperboloid gearing only transfer №3 possesses linear (before elastic rapprochement) contact of teeths, other three types (№№ 1, 2, 4) hypoid gears – dot contact. In this connection for transfer №3 on fig. 2 the additional information including, along with a median point of a line of instant contact, as well its trailer points is placed. Gears №1 and №3 are cut of gear cutter which giving is carried out along forming hypoid axoids at an axis crossing gear cutter and a axis of a cut wheel; gears №2 and №4 are cut cutter heads.

On score-resistance teeths (fig. 1 and 2): 1) it is essential higher "rating" gears №1 and №3 which initial surfaces least deviate from hyperboloid axiods possess; 2) gearing of Novikov the dominates over the involute; 3) highest "rating" transfer №1, possesses the lowest – transfer №4, intermediate position is occupied with gears №2 and №3, №5: the factor of transfer K_υ №1 in 1,5 … 5 times is less than factor of gears K_υ №2, №3, №4.

CONCLUSION

From fig. 3 it is visible, that the area of a platform of instant contact of transfer №1 in 5,5 … 9 times exceeds the area of a platform of instant contact of gears №2 - №5, hence, elastically strained a condition of teeths hyperboloid gearing with gearing Novikova essentially more low elastically strained conditions of teeth's hyperboloid gear with gearing of type Novikova that shows the big perspectivity of gearing Novikova, than involute gearings.

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О СОВЕРШЕНСТВОВАНИИ ПРОСТРАНСТВЕННЫХ ЗАЦЕПЛЕНИЙ

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Аннотация. Рассматривается синтез пространственных зацеплений на основе начальных поверхностей, наименее отклоняющихся от гиперболоидных аксоидов, что является перспективным направлением существенного увеличения прочности и улучшения эксплуатационных качеств винтовых, червячных, спироидных и гипоидных передач. Приведены результаты исследований, показывающих большую перспективность зацепления Новикова, чем эвольвентного зацепления.

Ключевые слова: пространственные зацепления, прочность, эксплуатационные качества, контактные напряжения, изгибные напряжения, зацепление Новикова.